Behavioral Risk Reduction in a Declining HIV Epidemic: Injection Drug Users in New York City, 1990–1997

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ABSTRACT

Objectives. This study assessed trends in HIV risk behaviors among injection drug users in New York City from 1990 to 1997.

Methods. Injection drug users were recruited continuously from a large drug detoxification treatment program (N = 2588) and a research storefront located in a high-drug-use area (N = 2701). Informed consent was obtained, and a trained interviewer administered a structured interview covering sociodemographics, drug use history, HIV risk behavior, and participation in syringe exchange.

Results. Trends were assessed for 5 risk behaviors in the 6-month period before the interview. The 3 injection risk behaviors declined significantly over time at each site (all $P < .01$). When data were pooled across sites, all 5 risk behaviors declined significantly over time (all $P < .01$). Participation in syringe exchange programs and in HIV counseling and testing increased greatly from 1990 to 1997.

*Conclusion*s. The continuing risk reduction among injection drug users indicates a "declining phase" in the large HIV epidemic in New York City. HIV prevention programs appear to be making an important contribution to the declining phase. (*Am J Public Health*. 2000;90:1112–1116)

The AIDS epidemic among injection drug users in New York City has been one of the largest local AIDS epidemics in the industrialized countries. More than 100 000 injection drug users have been infected with HIV, and more than 50 000 cases of AIDS have been reported among injection drug users, their sexual partners, and their children in New York City.[1] These AIDS cases among injection drug users and their sexual partners in New York City account for almost one tenth of the total AIDS cases in the United States[2] and amount to more than the total cases of AIDS that have occurred in any single European country.[3]

As in many other high-seroprevalence HIV epidemics, the epidemic among injection drug users in New York City has had distinct phases. HIV was introduced into the injection drug user population in New York City during the mid-1970s, and the virus spread rapidly among injection drug users during the late 1970s and early 1980s. During this period of rapid transmission, the estimated HIV incidence rate among injection drug users was 13 per 100 person-years at risk, and HIV seroprevalence reached approximately 50%.[4] From the mid-1980s through the early 1990s, seroprevalence remained stable at approximately 50%,[5] with an estimated seroincidence rate of 4.4 per 100 person-years at risk.[6] (The stable seroprevalence was a result of new infections balanced by a loss of persons who were HIV seropositive and the entry of persons who were HIV seronegative into the population.)

Recent evidence indicates a "declining" phase in this large HIV epidemic. HIV seroprevalence has declined in multiple samples of injection drug users in New York City.[7] Studies of injection drug users who are entering drug treatment programs, who are receiving treatment for sexually transmitted diseases, and who were recruited through street outreach and peer referral all have shown significant declines in seroprevalence from 1991 through 1996. Declines in prevalence occurred among both males and females, all major racial/ethnic groups, and all age groups. The average decline has been approximately 3% per year, leading to an overall decline from approximately 45% seroprevalence in 1991 to approximately 30% seroprevalence in 1996.

In addition, considerable evidence points to low HIV incidence among injection drug users in New York City. In 10 studies (conducted from 1992 through 1997), the overall incidence rate among injection drug users was 1 per 100 person-years at risk.[8] Injection drug use subjects in these studies were recruited from a variety of community outreach efforts, drug treatment programs, and sexually transmitted disease clinics. These 10 studies involved 4923 participants and more than 6000 person-years at risk. These incidence studies represent a very substantial reduction from the average incidence of 4.4 per 100 person-years at risk among injection drug users for studies conducted during the period of stable seroprevalence (1984–1991).[6]

We report here on trends in HIV risk behavior among injection drug users in New York City during the current "declining"

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This article was accepted December 9, 1999.

TABLE 1—Sociodemographic Characteristics of Injection Drug Users in New York City, 1990–1997

	Storefront (N = 2701)	BIMC Detox (N = 2646)	Difference[a]
Sex, %			
Female	28	19	$\chi^2_1 = 58$, $P < .001$
Male	72	81	
Age at interview, y, %			
<30	19	17	$\chi^2_1 = 4.76$, $P = .03$
>40	29	32	$\chi^2_1 = 2.98$, $P = .08$
Race/ethnicity, %			
White	27	19	
Black	43	33	
Hispanic	28	47	
Other	2	1	$\chi^2_3 = 217$, $P < .001$
Education, %			
≥High school	61	44	$\chi^2_1 = 151$, $P < .001$

Note. BIMC Detox = Beth Israel Medical Center drug detoxification program.
[a]Based on Mantel-Haenszel χ^2 test for trend.

phase of this large HIV epidemic. Declines in risk behavior would provide a possible causal mechanism for the reduced HIV incidence[8] and declining prevalence.[7]

Methods

Subject Recruitment and Data Collection

The data reported here are part of an ongoing series of studies of drug users entering the Beth Israel Medical Center drug detoxification program in New York City (methods described in Des Jarlais et al.[4,5]) and of drug users recruited at a research storefront located in the Lower East Side of Manhattan (methods described in Des Jarlais et al.[7]). The detoxification program serves the city as a whole; approximately half of its patients live in Manhattan, one quarter live in Brooklyn, one fifth live in the Bronx, and the rest (5%) live elsewhere. The program is quite large, with approximately 7000 admissions per year.

Patients in the detoxification program who had injected drugs were selected in a nonbiased manner for possible participation. Research staff visited the general admission wards of the program in a set order and examined the intake records to identify the most recent entrant to the ward who had injected drugs within the previous 2 months. The study was then fully described to the potential subject, and a signed informed consent was obtained from those who agreed to participate. Willingness to participate was very high; more than 95% of the detoxification patients who were approached agreed to participate in the study.

The Lower East Side is an area with a long history of high rates of drug use. Subject recruitment at the research storefront was primarily through word of mouth or peer referral. The research storefront has been in continuous operation since 1989 and is well known among drug users in the community. In addition to conducting research, the staff make referrals for drug users in need of services. We believe the storefront has a positive reputation among drug users in the area.

For reasons of legal informed consent, only persons 18 years or older were recruited at each site.

Although data collection was continuous, the sampling was conceptualized as "independent annual samples" from each of the 2 populations: (1) all admissions to the detoxification program within a calendar year and (2) all persons participating in the street drug scene in the vicinity of the research storefront within a calendar year. Thus, there was a 1990 sample, a 1991 sample, a 1992 sample, and so on from each of the 2 populations. No individual was sampled more than once per year. Many injection drug users receive detoxification treatment in more than 1 year, and many injection drug users participate in the street drug scene over many years. If an individual injection drug user was a member of a relevant population in more than 1 year, he or she would be eligible to be sampled in the different calendar years. Indeed, for independent annual samples, being sampled in 1 year should neither increase nor decrease the probability of being sampled in a following year.[9]

At each site, a trained interviewer administered a structured face-to-face interview covering sociodemographic characteristics, drug use, and HIV risk behavior. Most HIV risk behaviors were assessed for the 6-month period before the interview. In addition, we asked about some risk behaviors at the most recent drug injection, because memory for this recent event is likely to be relatively good. The interviewer also asked how the subject obtained injection equipment, with syringe exchange being one of the options. Subjects were paid small honoraria to compensate for their time and effort.

This article includes data collected from January 1990 through July 1997 from 2646 injection drug users recruited from the detoxification program and 2701 injection drug users recruited from the research storefront.

Data Analyses

Our primary interest in the analyses was to examine trends in risk behaviors during the 1990 to 1997 period. Risk behaviors were dichotomized into the presence and the absence of a specific behavior during the 6 months before the interview. We first used χ^2 tests for trends. Multiple logistic regression analyses were then used (SAS statistical package[10]) to control for possible changes in the sociodemographic composition of the sample.

Results

Table 1 presents sociodemographic characteristics of the subjects from each of the recruitment sites. Modest changes in these characteristics occurred over time, which will be examined elsewhere (S. R. Friedman et al., unpublished data, April 1999). The differences in demographic variables across sites (e.g., in race/ethnicity) reflect the different geographic areas served by the 2 sites. The detoxification program serves the city as a whole, whereas the research storefront serves the Lower East Side neighborhood. For the analyses in this report, we used the sociodemographic characteristics as control variables in the multivariate analyses presented below.

Table 2 presents trends in selected HIV risk behaviors. The injection risk behaviors declined significantly at each of the 2 sites. The sexual risk behaviors were less consistent—2 of the 4 declines reached statistical significance, and a third trend approached but did not reach significance.

We used multiple logistic regression to quantify the declines in risk behaviors over time and to determine whether the declines remained significant after statistical control for possible changes in the sex, age, and race/ethnicity composition of the samples. In these analyses, we pooled the data from both recruitment sites and used recruitment site as an additional control variable. Adjusted odds ratios were calculated for engaging in the specific risk behavior with a time variable

TABLE 2—Trends in HIV Risk Behaviors Among Injection Drug Users in New York City

Behavior in last 6 months, %	1990–1991 (n = 753)	1992–1993 (n = 905)	1994–1995 (n = 769)	1996–1997 (n = 287)	Difference[a]
Research storefront site (N = 2701)					
Any unsafe sex with casual partner	19	16	20	9	$\chi^2_1 = 2.82$, $P = .09$
Any unsafe sex with primary partner	50	47	43	39	$\chi^2_1 = 13.7$, $P < .001$
Any distributive needle sharing	40	39	34	19	$\chi^2_1 = 35.5$, $P < .001$
Any receptive needle sharing	42	33	30	24	$\chi^2_1 = 35.4$, $P < .001$
Any sharing at last injection	18	12	9	6	$\chi^2_1 = 37.8$, $P < .001$
Beth Israel Medical Center drug detoxification site (N = 2588)					
Any unsafe sex with casual partner	17	14	13	11	$\chi^2_1 = 8.14$, $P = .004$
Any unsafe sex with primary partner	44	38	36	44	$\chi^2_1 = 1.62$, $P = .20$
Any distributive needle sharing	51	44	37	26	$\chi^2_1 = 65.5$, $P < .001$
Any receptive needle sharing	42	36	30	27	$\chi^2_1 = 31.5$, $P < .001$
Any sharing at last injection	11	9	8	7	$\chi^2_1 = 7.56$, $P = .006$

[a]Based on Mantel-Haenszel χ^2 test for trend.

consisting of the successive 2-year periods (see Table 3). An adjusted odds ratio of less than 1.0 indicates that subjects interviewed in the later 2-year periods were less likely to be engaging in the risk behavior. All 5 adjusted odds ratios indicated statistically significant declines in the percentage of subjects engaging in the risk behaviors.

Whether HIV prevention programs are contributing to the current declines in risk behavior among injection drug users in New York City is a question of considerable importance for public policy. Our data permitted examination of possible associations between 2 prevention programs—HIV counseling and testing and syringe exchange—and risk behaviors during this period.

Data on HIV testing and obtaining injection equipment from syringe exchange programs are presented in Table 4. The use of these services clearly increased over time among our subjects at both recruitment sites. Use of syringe exchange increased dramatically over the 1990 to 1997 period (in part because of the legal authorization and public funding of the syringe exchanges, which occurred in late 1992). Thus, a temporal association was found between increasing use of these prevention services and the declines in HIV risk behavior during the early to mid-1990s.

We used a series of multiple logistic regression analyses to determine whether participation in either of these prevention services was associated with a lower probability of engaging in the risk behaviors in Table 2. From our discussions with subjects and our previous studies,[5,8] we presumed that HIV counseling and testing did not lead to a uniform reduction in risk behavior but rather led to differences in the behaviors of individuals who are HIV seropositive and HIV seronegative. Thus, we used "knowing that one is HIV seropositive" ("knowing HIV seropositive") as a predictor of engaging in risk behaviors rather than having been previously tested for HIV.

Table 5 presents the results of the multiple logistic regression analyses of knowing that one is HIV seropositive and of using the syringe exchange programs on the risk behaviors from Table 2. Knowing that one is HIV seropositive was associated with a significantly lower probability of engaging in unsafe sex with a primary sexual partner, unsafe sex with a casual sexual partner, and "distributive" syringe sharing (passing used injection equipment to others). In these behaviors, the person who is HIV seropositive may be particularly likely to transmit the virus to others.

Participating in a syringe exchange program was significantly associated with lower probabilities of "receptive" sharing (injecting with equipment used by others), any sharing (distributive or receptive) at the last injection event, and unsafe sex with primary and casual sexual partners. In these analyses, we controlled for other variables likely to be related to engaging in risk behaviors, including sociodemographic variables (sex, age, and race/ethnicity), recent drug use variables (injection frequency and crack cocaine use), drug history variables (years injecting, ever in drug treatment), and lifestyle variables (homelessness, sources of income, education, any male-with-male sex, marital status). Recruitment site and the 2-year periods from 1990 to 1992 through 1996 to 1997 also were included as control variables (full data not shown; available from the first author).

Discussion

HIV risk reduction among injection drug users in New York City began around 1984, when information about AIDS was widely disseminated in the injection drug user population.[11–13] The data presented here

TABLE 3—Time Period as a Predictor of Changing Risk Behaviors Among Injection Drug Users in New York City: Results From Logistic Regression Models (Combined Sample)

Dependent Variable	Odds Ratio for Independent Variable: "2-Year Period"	95% Confidence Limits Lower	95% Confidence Limits Upper	*P*
Any unsafe sex with primary partner	0.92	0.87	0.98	.006
Any unsafe sex with casual partner	0.89	0.83	0.97	.005
Any distributive sharing, last 6 mo	0.73	0.69	0.77	.0001
Any receptive sharing, last 6 mo	0.77	0.73	0.82	.0001
Any sharing at last injection	0.74	0.67	0.81	.0001

Note. The "2-year period" variable is defined in each model as an interval measure coded 1 through 4, beginning with the period 1990–1991 and ending with the period 1996–1997. All models were also controlled for age at interview, sex, race/ethnicity, and recruitment site.

TABLE 4—Trends in HIV Testing and Use of Syringe Exchange Among Injection Drug Users in New York City

Behavior, %	1990–1991	1992–1993	1994–1995	1996–1997	Difference[a]
Storefront site					
Any use of syringe exchange, last 6 mo	20	43	64	65	$\chi^2_1 = 274$, $P < .001$
Ever tested for HIV before interview	42	63	72	76	$\chi^2_1 = 158$, $P < .001$
Detoxification site					
Any use of syringe exchange, last 6 mo	20	38	43	42	$\chi^2_1 = 63.6$, $P < .001$
Ever tested for HIV before interview	60	75	84	87	$\chi^2_1 = 127$, $P < .001$

[a]Based on Mantel-Haenszel χ^2 test for trend.

show that reductions in risk behavior have continued during the current period of declining HIV seroprevalence[7] and low HIV incidence.[8]

The data reported here are based on self-reports from the subjects. Although the accuracy of self-reports is limited for sensitive behavior such as most HIV risk behaviors, the concurrent reductions in HIV prevalence and HIV incidence among injection drug users in New York City provide group-level validation of the declines in risk behaviors. Also, it should be noted that previous studies that used this basic questionnaire found strong relationships between self-reported risk reduction and lower rates of HIV infection.[14,15]

The simultaneous declines in prevalence, in incidence, and in risk behaviors appear to justify fully the term *declining phase* to describe the early to mid-1990s period among injection drug users in New York City. Two other recent studies have reported large high-seroprevalence HIV epidemics that may be in "declining phases." Evidence for declining risk behavior and prevalence has been reported from Uganda but with no decline in incidence.[16] Whether the decline in prevalence should be attributed to loss of persons who are HIV seropositive[16] or to risk reduction[17] has yet to be fully determined. Impressive declines in sexual risk behavior, prevalence, and incidence have been reported in young men from northern Thailand,[18] but the most recent data from this study indicate a rise in HIV infection associated with a very substantial increase in drug injection risk behavior.[19] The data from the epidemic among injection drug users in New York City would appear to be the strongest evidence to date for a declining phase in a large high-seroprevalence epidemic.

At present, it is not possible to determine how long the current positive trends in prevalence, incidence, and risk behavior will continue. The most likely scenario may be that HIV infection will fall to some "endemic" level of risk behaviors, incidence, and prevalence, although we cannot currently predict these endemic levels.

The data reported here were collected before any large-scale provision of highly active antiretroviral therapy to injection drug users in the city. The extent to which this treatment will be provided to injection drug users, whether it will reduce infectiousness among persons who are HIV seropositive, and whether its existence will affect risk behaviors among injection drug users in New York City all remain to be determined.

In addition, risk behavior and HIV infection may "rebound" in the injection drug user population. This could occur if support for HIV prevention programs were reduced. The history of tuberculosis in New York City provides a cautionary example. Tuberculosis had been declining for many years in the city, which led to a withdrawal of resources from tuberculosis control, which was then followed by a resurgence of tuberculosis.[20] One hopes that a similar scenario will not be repeated with HIV.

Whether the expansion of HIV prevention activities led to the declines in risk behaviors reported here is an important public health question. The data presented here constitute a strong epidemiologic argument for the causal effect of expanding the HIV prevention programs on reducing HIV risk behavior. From 1990 to 1997, the prevention programs underwent large-scale expansion, participation in the programs was associated with lower rates of risk behavior, and risk reduction occurred on a large scale. It is difficult to imagine an epidemic situation in which these events were occurring without expansion of the prevention programs at least contributing to the reduction in risk behaviors. The data presented here address the possibility of a direct causal link between participation in an HIV prevention program and reduced risk behavior.

TABLE 5—"Knowing HIV Positive" and "Use of Syringe Exchange" as Predictors of HIV Risk Behaviors Among Injection Drug Users in New York City (Combined Sample)

Dependent Variable	Odds Ratio for Independent Variable (95% CI)	*P*
Independent variable: "Knowing HIV positive"		
Any unsafe sex with primary partner	0.35 (0.27, 0.44)	<.00010
Any unsafe sex with casual partner	0.49 (0.35, 0.69)	<.0001
Any distributive sharing, last 6 mo	0.63 (0.51, 0.78)	<.0001
Any receptive sharing, last 6 mo	1.01 (0.82, 1.25)	.90
Any sharing at last injection	0.82 (0.58, 1.16)	.26
Independent variable: "Use of syringe exchange"		
Any unsafe sex with primary partner	0.84 (0.73, 0.97)	.02
Any unsafe sex with casual partner	0.81 (0.66, 0.99)	.04
Any distributive sharing, last 6 mo	0.94 (0.82, 1.09)	.43
Any receptive sharing, last 6 mo	0.80 (0.69, 0.93)	.004
Any sharing at last injection	0.64 (0.50, 0.81)	.0003

Note. All models controlled for age, sex, race/ethnicity, education, marital status, recruitment site, employment status, income source, homelessness, number of years injecting, injection frequency, crack use, treatment history, male-with-male sex (last 5 years), and time period. CI = confidence interval.

Indirect causal linkages are also possible. For example, the expansion of the syringe exchange programs undoubtedly increased the numbers of sterile syringes in circulation among injection drug users in the city. This increased availability of sterile injection equipment may well have contributed to the observed reductions in injection risk behavior among injection drug users who did not personally attend the exchange programs.

The reductions in risk behaviors reported here provide a possible causal mechanism for the previously reported reductions in HIV incidence and HIV prevalence among injection drug users in New York City during the same time period. At least one direct linkage exists between provision of HIV services and reduced risk behavior and lower HIV incidence. The syringe exchange programs expanded greatly beginning in 1992; participation in these programs was associated with both reduced risk behavior[21] and reduced HIV incidence.[22] Given the necessary epidemiologic linkages between HIV risk behavior and HIV incidence, it would not seem possible that large reductions in risk behavior and in incidence could occur in the same time period without the reductions in risk behavior at least partially contributing to the reduction in incidence. Again, given the complexity of the epidemic, it is also extremely likely that other factors in addition to reductions in risk behaviors contributed to the reduction in HIV incidence.

The data reported here are not the results of a randomized clinical trial; rather, they should be seen as part of a "case history" of a very large HIV epidemic. Quantification of likely causal linkages (from prevention program expansion to risk reduction to reduced incidence to reduced prevalence) will require modeling of the factors operating within the epidemic and systematic comparisons with other HIV epidemics. Within the limitations of drawing causal inferences, a strong pattern persisted in the data on the HIV epidemic among injection drug users in New York City from the early to the mid-1990s.

During this period, HIV prevention activities were expanded, including legalization and public funding of syringe exchange programs, and the percentages of injection drug users participating in syringe exchange programs more than doubled. Multiple risk behaviors were decreased by 40% or greater. HIV incidence was lowered; incidence was approximately 1 per 100 person-years at risk[8] compared with more than 4 per 100 person-years at risk previously.[6] Finally, HIV prevalence was reduced, from approximately 50% to approximately 30%.[7]

Together, these data suggest that it may be possible to "reverse" large high-seroprevalence HIV epidemics among persons considered to be at very high risk for HIV infection. □

Contributors

D. C. Des Jarlais conceived and developed the idea for the article; participated in the development and refinement of the intellectual content; wrote the first draft and subsequent drafts; discussed the ideas at scientific meetings worldwide; and contributed historical, ethical, and editorial expertise. T. Perlis, S. R. Friedman, D. Paone, and E. Monterroso participated in the conception and development of the idea for the article and of the intellectual content; wrote and edited numerous drafts, and contributed historical and ethical expertise. T. Chapman and J. Kwock managed and analyzed the data, partipated in the refinement of the intellectual content; contributed to numerous drafts, and provided statistical analysis expertise. R. Rockwell coordinated the project, contributed to early and final drafts; provided historical expertise, and coordinated various aspects of supervision of data collection. J. Milliken managed the administration of the project and contributed to the literature review and the discussion.

Acknowledgments

This research was supported by grant 2R01DA03574 from the National Institute on Drug Abuse and grant U64/CCU 209685 from the Centers for Disease Control and Prevention.

We acknowledge and thank all persons working in HIV prevention in New York City, including activists, the New York State Department of Health, and the American Foundation for AIDS Research.

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